



GA 6171

Attorney Docket No. 12369US01

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

PATENT APPLICATION OF:

JENS MULLER,  
PETER URBAN,  
REGINA WEZEL,  
KEVIN M. COLBOW and  
JIUJUN ZHANG

SERIAL NO. 09/256,386

FILED: February 24, 1999

FOR: DIRECT DIMETHYL ETHER  
FUEL CELLS

Group Art Unit: 1745

Examiner: Not yet assigned

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) June 15, 1999  
)  
) Robert W. Fieseler  
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INFORMATION DISCLOSURE STATEMENT

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JUN 24 1999

GROUP 1745

Assistant Commissioner for Patents  
Washington, D.C. 20231

Sir:

Applicant submits herewith a copy of each of the  
following references for consideration by the U.S. Patent and  
Trademark Office in connection with the above application.

| <u>U.S. Patent No.</u> | <u>Inventor(s)</u> | <u>Issue Date</u> |
|------------------------|--------------------|-------------------|
| 4,450,055              | Stafford           | 05/84             |
| 5,723,228              | Okamoto            | 03/98             |
| 5,747,185              | Hsu                | 05/98             |
| 5,856,036              | Smotkin et al.     | 01/99             |

| <u>Foreign Patent No.</u> | <u>Country</u> | <u>Date</u> |
|---------------------------|----------------|-------------|
| 4-132168                  | Japan          | 05/92       |
| 6-310166                  | Japan          | 11/94       |
| WO 96/12317               | PCT            | 04/96       |
| WO 96/18573               | PCT            | 06/96       |
| 0 754 649                 | Europe         | 01/97       |
| 10-189022                 | Japan          | 07/98       |

| <u>Publication</u>   | <u>Author(s)</u> | <u>Date</u> |
|--|------------------|-------------|
| "The Processing of Alcohols, Hydrocarbons and Ethers to Produce Hydrogen for a PEMFC for Transportation Applications", Special Projects Group, Wellman CJB Limited, Airport Service Road, Portsmouth, Hampshire, PO3 5PG, United Kingdom pp. 837-842 | Dams et al.      | No date     |

| <u>Publication</u>  | <u>Author(s)</u> | <u>Date</u> |
|---|------------------|-------------|
| "Dimethyl Ether as a<br>Transportation Fuel: A<br>State-of-the-Art Survey",<br>J.E. Sinor Consultants,<br>Inc. pp. 2-3, 10-11,<br>22-25, 33-34, 46-48,<br>52-54 | No author        | 06/97       |

The above references are listed on the enclosed Form PTO-1449  
entitled "Information Disclosure Citation".

Concise Explanation of The  
Relevance Of The Cited References

Stafford U.S. Patent No. 4,450,055 discloses a  
electrogenerative partial oxidation of organic compounds  
comprising contacting a palladium anode with a methyl-  
substituted hydrocarbon in a fuel cell containing an acidic  
aqueous electrolyte to form corresponding aldehyde and  
carboxylic acid products.

Okamoto U.S. Patent No. 5,723,228 discloses a direct methanol  
type fuel cell in which an aqueous methanol solution is directly  
supplied along a fluid passage and in which the oxygen containing  
gas fluid passage flows in the opposite direction of the aqueous

methanol solution, thereby minimizing the temperature distribution in the fuel cell unit.

Hsu U.S. Patent No. 5,747,185 discloses a high temperature electrochemical converter for hydrocarbon fuels in which the converter has an electrolyte layer with a fuel electrode material on one side and an oxidizer electrode material on the other side, and an interconnector having opposed contact surfaces. The interconnector is coupled to adjacent electrode surfaces, thereby providing an electrical connection between the electrodes. The electrochemical converter has a low internal resistance that is capable of directly processing hydrocarbon fuel having a sulfur component of up to about 50 ppm without suffering permanent decrease in overall operating performance.

Smotkin et al. U.S. Patent No. 5,856,036 discloses a catalyst for use in direct oxidation fuel cells or other electrochemical reactor devices operating in the temperature range of up to about 200°C. The catalyst comprises platinum, ruthenium and osmium and has a single phase crystal structure consisting of face-centered cubic unit cell. When platinum, ruthenium and osmium are substituted into a face-centered cubic crystal structure, a highly active catalytic surface for the

electrochemical oxidation of molecules, such as methanol, is created.

Japanese Unexamined Patent Publication (Kokai) No. 4-132168 discloses electrodes for use in a liquid fuel cell comprising an oxidant electrode and a fuel electrode in which one of the electrodes contains a polymer with ion exchange groups added to the oxidant electrode in order to provide the oxidant electrode itself with the ability to block methanol.

Japanese Unexamined Patent Publication (Kokai) No. 6-310166 discloses a portable fuel cell power source comprising a fuel cylinder, an aqueous methanol solution, a fuel reformer, a cell stack, and a case. The fuel cylinder has a detachable connection to the fuel reformer, thereby making it easier to change fuel tanks.

Japanese Unexamined Patent Publication (Kokai) No. 10-189022 discloses a fuel cell in which dimethyl ether is utilized as a starting fuel. The dimethyl ether is fed to a reformer with water vapor and then to an anode of the fuel cell. An oxidant gas is fed to the cathode of the fuel cell together with water vapor.

European Patent No. 0 754 649 A1 discloses the production of a hydrogen-rich gas in which the feed stock consists of dimethyl ether and steam. The dimethyl ether is reacted with steam in the presence of an ether hydration catalyst and a methanol decomposition catalyst.

PCT/International Publication No. WO 96/12317 discloses an improved liquid feed direct fuel cell that employs a solid polymer electrolyte membrane in combination with a battery-type anode structure and a cathode. The components are bonded to either side of the solid polymer proton-conducting membrane, thereby forming a membrane electrode assembly.

PCT/International Publication No. WO 96/18573 discloses a process for producing hydrogen and carbon oxides from dimethyl ether which comprises passing a feed stream which includes 1 to about 6 molar parts steam and one molar part dimethyl ether to a hydroshifting reaction zone including an essentially alkali metal-free catalytic composition composed of copper or nickel to produce a product stream.

The undated publication by Dams et al. entitled "The Processing of Alcohols, Hydrocarbons and Ethers to Produce Hydrogen for a PEMFC for Transportation Applications" discloses feedstock options available by incorporating a methanol reformer and catalytic gas clean-up system which includes steam and partial oxidation reforming, non-catalytic and catalytic partial oxidation.

The 1997 publication entitled "Dimethyl Ether as a Transportation Fuel: A State-of-the-Art Survey" discloses dimethyl ether having almost ideal combustion characteristics for a diesel fuel. The publication states that the high vapor pressure of dimethyl ether improves atomization and makes it possible to achieve good combustion and low emissions without relying on high injections pressures. According to the publication, however, high vapor pressure creates problems with bulk transport and distribution and with onboard fuel storage and feed systems.

Please charge any fees incurred in connection with this submission to Deposit Account No. 13-0017.

Respectfully submitted,

A handwritten signature in dark ink, appearing to read 'Robert W. Fieseler', written over a horizontal line.

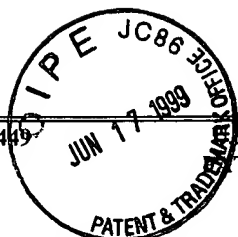
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Form PTO-1449  
(Rev. 8-83)  
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U.S. DEPARTMENT OF COMMERCE  
PATENT AND TRADEMARK OFFICE

ATTY. DOCKET NO.  
12369US01

SERIAL NO.  
09/256,386

APPLICANT(s):  
Muller, et al.

FILING DATE  
February 24, 1999

GROUP ART UNIT:  
1745

# **INFORMATION DISCLOSURE CITATION** (Use several sheets if necessary)

## **U.S. PATENT DOCUMENTS**

| EXAMINER<br>INITIAL | DOCUMENT<br>NO. | DATE     | NAME           | CLASS | SUBCLASS | FILING DATE<br>IF<br>APPROPRIATE |
|---------------------|-----------------|----------|----------------|-------|----------|----------------------------------|
|                     | 4,450,055       | 05/22/84 | Stafford       | 204   | 78       |                                  |
|                     | 5,723,228       | 03/03/98 | Okamoto        | 429   | 12       |                                  |
|                     | 5,747,185       | 05/05/98 | Hsu            | 429   | 44       |                                  |
|                     | 5,856,036       | 01/05/99 | Smotkin et al. | 429   | 40       |                                  |
|                     |                 |          |                |       |          |                                  |
|                     |                 |          |                |       |          |                                  |
|                     |                 |          |                |       |          |                                  |
|                     |                 |          |                |       |          |                                  |
|                     |                 |          |                |       |          |                                  |

## **FOREIGN PATENT DOCUMENTS**

| EXAMINER<br>INITIAL | DOCUMENT NO. | PUBLICATION<br>DATE | COUNTRY | CLASS | SUBCLASS | TRANSLATION |    |
|---------------------|--------------|---------------------|---------|-------|----------|-------------|----|
|                     |              |                     |         |       |          | YES         | NO |
|                     | 4-132168     | 05/06/92            | Japan   |       |          | X           |    |
|                     | 6-310166     | 11/04/94            | Japan   |       |          | X           |    |
|                     | 10-189022    | 07/21/98            | Japan   |       |          | X           |    |
|                     | 0 754 649 A1 | 01/22/97            | Europe  |       |          |             |    |
|                     | WO 96/12317  | 04/25/96            | PCT     |       |          |             |    |
|                     | WO 96/18573  | 06/20/96            | PCT     |       |          |             |    |

## **OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)**

|  |  |
|--|--|
|  | Dams, et al., "The Processing of Alcohols, Hydrocarbons and Ethers to Produce Hydrogen for a PEMFC for Transportation Applications," Special Projects Group, Wellman CJB Limited, Airport Service Road, Portsmouth, Hampshire, PO3 5PG, United Kingdom pp. 837-842 (no date) |
|  | "Dimethyl Ether as a Transportation Fuel a State of the Art Survey," J.E. Sinor Consultants, Inc. pp. 2-3, 10-11, 22-25, 33-34, 46-48, 52-54 (June , 1997)   |
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EXAMINER

DATE CONSIDERED:

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\*EXAMINER: Initial citation considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and be considered. Include copy of this form with next communication to applicant.

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